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Notes on the Snakes of the Genus *Salvadora*

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ABSTRACT: A brief synopsis, with a key, is presented of the differential characters of the six species and subspecies of the genus *Salvadora*. The study is based on thirty-three specimens, twenty-three of which are from Mexico, representing all known forms of the genus.

THE following notes are based upon thirty-three specimens, mostly Mexican, of six species and subspecies of *Salvadora*. Most of the material is contained in the Mexican collection of Dr. E. H. Taylor and myself. Catalogue numbers, unless otherwise stated, refer to specimens in this collection. The remainder of the material studied is in the Dyche Museum of Natural History at Kansas University. These specimens are designated by KU.

Two rather distinct groups in the genus are apparent, one containing *mexicana* and *pulcherrima*, the other containing *bairdii*, *grahamiae*, *hexalepis* and *virgultea*. The separate identity of *bairdii* is beyond question, but its relationship to *grahamiae* is yet uncertain. Most recent authors have considered *grahamiae* and *hexalepis* subspecies of each other. With reluctance I have adhered to this conclusion, but the matter does not seem definitely proved.

I am indebted to Dr. E. H. Taylor for assistance in the preparation of this paper, and for making possible the collection of much of the Mexican material; and to Mr. C. D. Bunker for permission to study the material in the Dyche Natural History Museum.

KEY TO THE FORMS OF THE GENUS SALVADORA

1. One preocular; tail thirty percent of total length, or more; subcaudals 121 to 139; three supralabials entering eye; rostral not greatly enlarged 2
   Two or more preoculars; tail less than thirty percent of total length; subcaudals 82 to 103; one or two supralabials entering eye; rostral sometimes greatly enlarged 3
2. Stripes extending the full length of body and tail ..... *pulcherrima*, p. 230
   Stripes broken on anterior part of body and replaced on neck by indistinct crossbands ..... *mexicana*, p. 231

3. Anterior section of nasal separated from second supralabial; dorsolateral dark stripes terminating on nape, not passing over temporal region of head....*bairdii*, p. 232
Anterior section of nasal in contact with second supralabial; dorsolateral dark stripes may or may not pass across temporal region to eye..... 4
4. Two loreals; second supralabial separated from loreals; nine or ten supralabials.. 5
One loreal; second supralabial in contact with loreal; eight, rarely nine, supralabials; dorsolateral dark stripes passing across temporal region to eye.
g. grahamiae, p. 234
5. Middorsal light stripe one and two half scale rows wide on fore part of body; a single, broad, dark band on either side of middorsal light stripe, not passing onto temporal region, but fusing generally with color of head; usually only the sixth supralabial entering eye.....*g. virgultea*,* p. 236

Middorsal light stripe three scales wide on fore part of body (wider on neck); two dark bands lateral to middorsal light stripe, narrowly separated from each other; a distinct, dark, temporal stripe, continuous with upper dark band on body; usually two or more supraoculars enter eye.....*g. hexalepis*, p. 235

Salvadora pulcherrima (Cope)

(Plate XXII)

One specimen, a male (No. 4669), was collected near San Ricardo, Chiapas, September 2, 1936. It was found moving about the base of a red sandstone cliff.

The essential features of scutellation are: parietals truncate posteriorly; frontal emarginate on sides, wider anteriorly than posteriorly, slightly wedged between the parietals posteriorly, its length on a median line somewhat greater than that of the median suture of the parietals; prefrontals wider than long, extended onto loreal region; internasals as long as broad, rounded anteriorly, the median suture between them about two thirds the length of the median suture between prefrontals; maximum length of prefrontals slightly greater than that of internasals; rostral nearly one and one half times as long as broad, wedged posteriorly between internasals; anterior section of nasal subequal in size to posterior section, not in contact with second supralabial; dorsal border of naris formed by internasal; loreal single, narrow, elongate; one large preocular, extending dorsad and nearly completely separating prefrontal from supraocular; preocular in contact only with third supralabial; supraocular wider posteriorly than anteriorly, its greatest transverse diameter somewhat less than that of frontal; two postoculars, the lower somewhat smaller than upper; supralabials 8-8, the second and third in contact with loreal, the third, fourth and fifth entering eye (third very narrowly); temporals 2-2 on each side; infralabials 11-11, the first pair in contact on the median ventral line; two pairs of genials, the length of the first pair, on the median ventral line, slightly less than that of second pair; scales of second pair of genials

* Characters as proposed by Bogert (Bull. Southern Calif. Acad. Sci., vol. 34, part 1, 1935, pp. 88-94), with the exception of the absence of a temporal stripe.

separated by two small median scales anteriorly, by three scales posteriorly.

Dorsal scales smooth, with two apical pits, in 17-17-13 rows; gastrosteges 199; urosteges 138. The total length is 1,056 mm.; tail, 345 mm.; the latter is 32.7 percent of the total length.

The color pattern is quite distinctive. Most of the head scales are edged with black; general ground color of head light olive; ground color of body light olive anteriorly, fading to cream posteriorly; four distinct, black stripes on neck; the two medial stripes begin three scales back of the parietals; they are two scales wide on the nape and are separated medially by a light stripe five scales wide; a very short distance posteriorly they are separated by a width of three scales, diminishing to a width of one scale one fourth the distance from the snout; on the tail the median light stripe becomes narrower, very light brown, and occupies parts of two adjacent scale rows; the black stripes on either side of the middorsal light stripe become dark brown near the middle of the body and progressively lighter posteriorly; near the middle of the body, the scales near the edges of the dorsolateral dark stripes are dark-edged, while posteriorly only the upper edges of the scales on the lateral border of the dark stripes are black.

The lateral black stripes extend from the posterior border of the eye through the temporal region to the neck, where they are broken by a light area about the length of four scales; they continue posteriorly from the neck, where they are about two half scale rows wide, to the tail, becoming brownish on the posterior fourth of the body; over most of the length of the body the lateral stripes are one and one half scale rows wide, including the upper half of the lateral scale rows.

The belly and the ventral half of the first dorsal scale row are immaculate white; the chin and all except the upper edges of the supralabials are white.

Salvadora mexicana (Duméril and Bibron)

Thirteen specimens are available, from the following localities: *Colima:* Manzanillo (No. 4676). *Michoacán:* Hacienda El Sabino (Nos. 4680, 5265-8). *Guerrero:* Mexcala (Nos. 4673, 5269, 15424); 1 mi. N. of Organos, S. of El Treinte (No. 4674); El Treinte (No. 5270); Palo Blanco, S. of Chilpancingo (No. 4675).

This species agrees with *pulcherrima* in most respects, but has a somewhat larger rostral and the supralabials are nine on each side

instead of eight. The anterior section of the nasal is separated from the second supralabial in all specimens. The fourth, fifth and sixth supralabials border the orbit in all except one side of one specimen, in which the fourth is narrowly excluded by contact of the preocular and fifth supralabial. The dorsal scale formula is 17-17-13 in all. The infralabials are eleven except on one side of one specimen, and on both sides of another, in which there are ten.

Measurements (in mm.) and scale counts of *S. mexicana*

NUMBER.	Sex.	Ventrals.	Caudals.	Total length.	Tail.	Percent tail of total.
5266	♀	192	129	555	174	31.4
5269	♀	186	137	918	309	33.7
4676	♂	189	121	656	210	32.0
4673	♂	181	132	760	258	33.9
4675	♂	186	141	797	274	34.3
15424	♂	188	137	841	289	34.4
5267	♂	191	131	1,032	341	33.0
5268	♂	187	123	1,049	337	32.1
4674	♂	185	131	1,063	341	32.1
5265	♂	185	128	1,092	362	33.2
5271	♂	187	139	1,140	386	33.9
5270	♂	188	134	1,274	425	33.4
4680	♂	186	132	1,330	432	32.5

The species differs widely from others of the genus in coloration. The striped pattern is replaced on the anterior third or fourth of the body by a speckled pattern; on the neck the dark spots are arranged in irregular, indefinite cross-bars about six in number. Each dorsal head scute has a large, light area in the middle, surrounded by a darker area around the edge of the scale. A dark spot occurs at the lateral anterior edge of each caudal scute.

Salvadora bairdii (Jan)

Seven specimens are available, from the following localities: *Vera Cruz:* 1½ mi. W. of Acultzingo (Nos. 4668-9). *Puebla:* 12 mi. N. of Tehuacán (No. 5264). *Guanajuato:* San Felipe (No. 4670). *Jalisco:* Magdalena (Nos. 4670A, 4671). *Michoacán:* Uruapan (No. 4672).

The species is similar to *grahamiae grahamiae*, with which it has been synonymized by some authors, in most characters of cephalic

scutellation. There are eight supralabials; usually nine infralabials (10 on one side in two specimens); two preoculars; two postoculars; lower preocular wedged between third and fourth supralabials; second and third supralabials bordering loreal; latter single, deep; fourth and fifth supralabials enter eye. However, there are three definable differences in the cephalic scutellation of *grahamiae grahamiae* and *bairdii*. In the latter the anterior part of the nasal is not pushed back by the rostral, and is separated from the second supralabial by contact of the first supralabial and the posterior part of the nasal. In *g. grahamiae* the anterior section of the nasal is in contact with the second supralabial, presumably due to the enlargement of the rostral. In *g. hexalepis* the rostral is still further enlarged, resulting in a broader contact of the two scales mentioned.

Secondly, the rostral is not enlarged in *bairdii* as in *g. grahamiae*, and the lateral edges are but very slightly free. The outline of the anterior face of the rostral, in dorsal or ventral profile, is rounded in *bairdii*, nearly straight in *g. grahamiae*.

Thirdly, the second pair of genials in *bairdii* are separated throughout their length, as is usually the case in *g. hexalepis*; in *g. grahamiae* the scales usually are in contact throughout most of their length, being separated only posteriorly.

Further, the pre- and postoculars seem to vary less in *bairdii* than in *g. grahamiae*. There are invariably two pre- and two postoculars in the specimens examined of *bairdii*, while in six specimens of *g. grahamiae* the preoculars are 2-2, 2-2, 2-3, 2-3, 2-3, 3-4, and there are three postoculars on one side in one.

In ventral and caudal counts and in tail-total length proportions no differences are discernible.

The color pattern of *bairdii* is essentially similar to that of *g. grahamiae*, but there are two definite and constant differences. The dorsolateral dark stripes in *bairdii* are distinctly black-edged medially except on the posterior part of the body, not in *g. grahamiae*. In the latter the dorsolateral dark stripes pass distinctly onto the head, through the temporal region to the eye, while in *bairdii* the stripes terminate on the nape just posterior to the parietal and temporal regions.

Further, the narrow, lateral dark stripe in *bairdii* extends farther forward than in *g. grahamiae*. The median dorsal light stripe in the latter species is one and two half scale rows wide on the body near the anus, while in all but one specimen of *bairdii* the dorsal stripe has narrowed to the width of one scale row at this point.

In *bairdii* dark blue, irregular, vertical lines passing from the lateral dark line to the ventrals, frequently are visible on the neck. These are not or scarcely discernible in *g. grahamiae*.

Salvadora grahamiae grahamiae and *bairdii* are undoubtedly closely related—apparently more closely than *g. grahamiae* and *g. hexalepis*, as indicated by the greater number of definable differences between the latter two than between the former two. Upon the basis of present knowledge, however, it can merely be stated that *bairdii* and *g. grahamiae* are distinct from each other. The degree of difference between related forms is no criterion for determining whether the forms are species or subspecies. Two subspecies of a single species may have more obvious, more numerous and more easily defined differences (*e. g., Sceloporus m. magister* and *m. rufidorsum*) than two closely related forms known to be distinct, specific entities through the existence of other evidence (*e. g., Sceloporus m. magister* and *c. clarkii*). In the absence of evidence in the form of geographic trends of variation indicative of a blending of differential characters in an area between the known ranges of the two forms in question, I prefer to retain them as separate species.

Measurements (in mm.) and scale counts of *S. bairdii*

NUMBER.	SEX.	VENTRALS.	CAUDALS.	TOTAL LENGTH.	TAIL.	PERCENT TAIL OF TOTAL.
4672	♀	194	90	261	54	20.7
4668	♀	191	94	297	70	23.6
5264	♀	206	95	353	81	22.9
4670	♀	209	98	663	163	24.6
4670A	♀	197	.....	688	.....	.....
4669	♂	185	100	254	61	24.0
4671	♂	186	95	694	182	26.2

Salvadora grahamiae grahamiae Baird and Girard

Six specimens are in the collections, from the following localities: *Nuevo León:* Spring three miles west of Sabinas Hidalgo (No. 4677). *Texas:* Arroyo El Salado, 13 m. SE of Rio Grande City, Starr Co. (No. 4678); Lytle, Atascosa Co. (KU 11668). *New Mexico:* Carlsbad Caverns, Eddy Co. (KU 8380); Santa Rita, Grant Co. (KU 2142). *Arizona:* Montezuma Canyon, Huachuca Mts. (KU 5467).

Supralabials eight, except in one in which nine are present on one side; infralabials nine, except in one in which ten occur (both sides);

preoculars 2-2, 2-2, 2-3, 2-3, 2-3, 3-4; postoculars two, except on one side of one, where three occur; lower preocular inserted between third and fourth supralabials, except on one side of one (between fourth and fifth); second and third supralabials in contact with loreal; fourth and fifth supralabials usually entering eye (fifth and sixth on one side in one).

The anterior section of the nasal is in contact with the second supralabial in all. In two specimens, the second pair of genials are separated throughout their length.

Measurements (in mm.) and scale counts of *S. g. grahamiae*

NUMBER.	Sex.	Ventrals.	Caudals.	Total length.	Tail.	Percent tail of total.
11668	♀	189	92	918	222	24.2
4677	♂	185	94	516	135	26.2
2142	♂	.....	92	724	188	26.0
8380	♂	191	103	752	202	26.9
5467	♂	184	97	847	218	25.7
4678	♂	187	85	909	222	24.4

Salvadora grahamiae hexalepis (Cope)

Five specimens, from the following localities: *Sonora:* 50 kilom. S. of Nogales (No. 15426). *Arizona:* Roosevelt Dam, Gila Co. (KU 8429); Mohawk, Yuma Co. (KU 6997); Phoenix, Maricopa Co. (KU 8488); Tucson, Pima Co. (No. 4679).

Dorsal scales in 17-17-13 rows, as in *g. grahamiae* and *bairdii;* supralabials 9-9 in two, others 9-10, 10-10; infralabials 9-10, 10-10, 10-11, 11-11; preoculars two in all; postoculars 2-3 in one, 2-2 in others; anterior section of nasal in contact with second supralabial in all; loreals 2-2 in two specimens, 2-3 in one, 3-3 in two; third and fourth supralabials in contact with loreals, except on one side in two specimens, in which the third, fourth and fifth supralabials are in contact with the loreals; lower preocular wedged between the fourth and fifth supralabials except on one side in two specimens, in which it is wedged between the fifth and sixth. The supralabials entering the eye are as follows: 5-6-7, 7; 6,6; 6,6; 0,5. In the latter specimen, the sixth supralabial, which should enter the eye, is split transversely. A subocular, split usually from the upper edge of the fifth supralabial, is present on both sides in three, on one side in one (head crushed in other specimen). The second pair of genials are in contact in one specimen.

The subspecies differs from *g. grahamiae* in numerous characters: number of supralabials (nine or ten in *hexalepis,* eight or rarely nine in *grahamiae*); number of infralabials (nine to eleven, usually eleven, in *hexalepis;* nine or ten, usually nine, in *grahamiae*); number of loreals (two or three in *hexalepis,* one in *grahamiae*); second supralabial (in contact with loreal in *grahamiae,* not in *hexalepis*); rostral wider in *hexalepis;* anterior section of nasal more broadly in contact with second supralabial; second pair of chinshields more frequently separated in *hexalepis;* and ventral scales more numerous in *hexalepis.*

Measurements (in mm.) and scale counts of *S. g. hexalepis*

NUMBER.	Sex.	Ventrals.	Caudals.	Total length.	Tail.	Percent tail of total.
8488	♀	201	82	709	154	21.7
6997	♀	207	95	826	182	22.0
4679	♂	201	86	684	163	23.8

Salvadora grahamiae virgultea Bogert

One specimen examined, from Escondido, San Diego county, California (KU 8487). It is a young female, agreeing in most characters with Bogert's description (Bull. Southern Calif. Acad. Sci., Vol. 34, 1935, part 1, pp. 88-94). The dorsals are in 17-17-13 rows; ventrals 201; caudals 84; supralabials 9-9; infralabials 11-11; preoculars 2-2; postoculars 2-2; loreals 2-2; third and fourth supralabials touch loreals; lower preocular between fourth and fifth supralabials; fifth and sixth supralabials enter eye on one side, sixth on other; subocular present on one side; total length 277 mm.; tail 59 mm.; ratio, tail to total length, .213.

In addition to the characters pointed out by Bogert, it appears that *g. virgultea* differs from *g. hexalepis* also in lacking a distinct, dark temporal stripe. It agrees in this respect with *bairdii.*

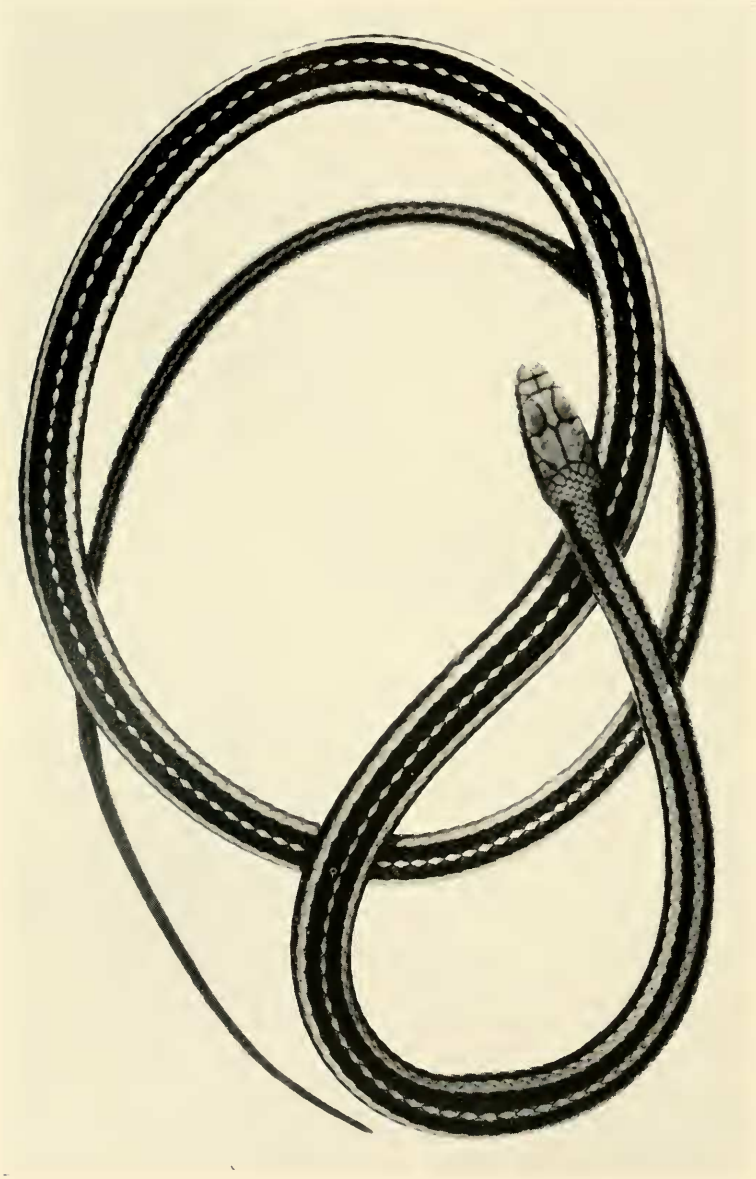

PLATE XXII

Salvadora pulcherrima. San Ricardo, Chiapas. Total length, 1056 mm.